

IV. Remarks

Reconsideration and allowance of the subject application are respectfully requested.

Claims 1-13 are pending in the application. Claims 1 and 13 are independent.

Drawings

Figures 1, 2A and 2B are now labelled as "Prior Art". Reference numeral "20" is now shown in Figure 3. Figure 4 is corrected to show reference numeral "96" referring to a "transducer scanning control module" as is described on page 8 lines 4 and 6.

Specification

The specification has been amended at page 5, 11, 12 and 13 to correct various typographical errors. No new matter has been added.

Claim objections

Claim 6 has been amended to end in a period. Claim 12 has been amended to correct a clerical error.

Claim Rejections - 35 U.S.C. §112 First Paragraph

Claim 12 was rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. The Office Action states that "the reverse map encloses edges of each two-dimensional image" and refers to page 12, lines 11-15 and 30-31 as well as Figures 9A and 9B. Applicants respectfully traverse this rejection. Claim 12 is fully supported by the description on page 12, lines 8-15 referring to Figures 7A and 7B. This passage clearly supports claim 12.

Claim Rejections - 35 U.S.C. §112 Second Paragraph

Claims 4, 9, 10 and 13 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicant regards as the invention. Applicants respectfully traverse this rejection on the ground

that the person of ordinary skill in the art would not be confused as to the meaning or scope of the claims. Nevertheless, these claims have been amended for clarity with the specification and Drawings, and not in response to any statutory requirement.

Claim Rejections - 35 U.S.C. §102

Claims 1, 3 and 13 are rejected under 35 U.S.C. 102(b) as being anticipated by Quistgaard (U.S. 5,485,842). Applicants respectfully traverse all art rejections.

Quistgaard is directed to a method and apparatus for processing a plurality of ultrasound acquired scan planes in order to present a three dimensional image of a target tissue. Through conventional scan conversion techniques two-dimensional images are processed to approximate their rotation to various acquired scan planes and projection back to a reference plane such as the original image plane. These stored images comprise a set of corresponding projected images offset with respect to each other. Each combined image is a different view of a three dimensional region occupied by the planar image information. It is the sequence of the entire combined images which may be replayed on a display to depict the three dimensional region as if it is rotating in front of a viewer. Thus, the combined three-dimensional image comprises a set of corresponding projected images offset with respect to each other.

In contrast, the presently claimed invention is directed to a method and system for fast linear reconstruction of fan and axially acquired ultrasound data to rapidly and accurately provide a three dimensional image of a target tissue. Fast linear reconstruction has never been previously shown with respect to fan and axially acquired ultrasound data. In the presently claimed method, only the specific image data from fan and axially acquired two dimensional image slices that are actually required to view the user-selected image undergoes reconstruction. Thus a series of fan and axially acquired images of a target tissue or volume are obtained via an angular scanning technique and only those data required to view the user-selected image undergoes reconstruction. Thus the combination of fan and axially acquired images together with fast linear reconstruction provides for the rapid, accurate and high-resolution three-dimensional images.

Claim 1 recites "transformation means responsive to user selection of a three-dimensional image surface to be displayed, said transformation means receiving the digitized two-dimensional images and the data set representing the three-dimensional image; and transforming only image data within the received two-dimensional images that is necessary to

view the selected three-dimensional image surface. Similarly, claim 13 has been amended to recite "transforming the digitized two-dimensional images and the data set representing the three-dimensional image and transforming only image data within the received two-dimensional images that is necessary to view at least a portion of the selected three-dimensional image surface". Both of these amendments are supported by the application as filed and for example on pages 2-3 of the description. It is asserted that the present claims are both novel and inventive over the cited prior art of record.

Accordingly, the claims are fully patentable over Quistgaard.

Claim Rejections - 35 U.S.C. 103

Claims 2 and 5 are rejected under 35 U.S.C. 103(a) as being unpatentable in view of Quistgaard and further in view of Fenster (U.S. 5,454,371). Applicants respectfully traverse all art rejections. Quistgaard is discussed above. Fenster discloses a 3D ultrasound imaging system. While Fenster may disclose an axial scanning of the probe or compensation of image with respect to tilt offset, the Examiner acknowledges that Quistgaard is deficient in such teaching. Fenster does not teach or suggest fast-linear reconstruction of fan and axially acquired data as is recited in claim 1. As such, Fenster cannot render these claims obvious.

Claims 4, 9 and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Quistgaard in view of Fenster (U.S. 5,842,473) and further in view of Hossack (U.S. 6,360,027). Applicants respectfully traverse all art rejections. The Office Action admits that Quistgaard only discloses storage of acquired images. Fenster is relied upon to teach storage of an address pointer of the location of the images, horizontal and vertical voxel sizes and width and height of each acquired image Hossack is relied upon to teach the storage of the location of the axis of rotation with respect to each image, the location of each acquired image to the transducer and the angular separation of each image. While these references may disclose such aspects of the particular imaging system disclosed in the references they do not suggest such aspects in conjunction with a three-dimensional imaging system where only specific image data from fan and axially acquired two dimensional image slices actually required to view the user-selected image undergoes reconstruction. This requirement is recited in claim 1, from which claims 4, 9 and 10 dependent from directly or indirectly. As such the combination of the teachings of these references is deficient and does not suggest the claimed invention.

Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Quistgaard and further in view of Fenster (U.S. 5,842,473) and Hossack. Fenster is relied upon for teaching calibration of horizontal and vertical voxel sizes and Hossack is relied upon for teaching storing of the location of the axis of rotation with respect to each of the images. Again as argued above, these elements do not teach or suggest the fast-linear reconstruction of only the required fan and axially acquired ultrasound data that makes up the user selected image. As claim 6 is dependent on claim 1, it cannot be rendered obvious by the teachings of the references cited by the Examiner.

Claim 7 is rejected under 35 U.S.C. 103(a) as unpatentable over Quistgaard, Fenster (U.S. 5,842,473), Hossack and Fenster (5,454,371). Claim 8 is rejected under 35 U.S.C. 103(a) as unpatentable over Quistgaard, Fenster (U.S. 5,842,473) and Hossack. Claims 7 and 8 are directly or indirectly dependent on claim 1. Neither cited reference alone or in combination teaches or suggests the transformation of any image data within the received two-dimensional images obtained by fan and axially acquired ultrasound data necessary to view the selected three-dimensional image surface. As such, these references cannot render obvious claims 7 or 8.

Claims 11 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Quistgaard in view of Yamazaki (U.S. 5,497,776). The Office Action admits that Quistgaard is silent as to the teaching of a means to generate a reverse map.

Yamazaki does not disclose a means to generate a reverse map, and further does not disclose such a means that receives digitized two-dimensional images and the data set representing the three-dimensional image, where the transformation means only transforms image data within the received two-dimensional images necessary to view the selected three-dimensional image surface. As to claim 12, Yamazaki is silent to a transformation means as just described in which a reverse map includes the edges of each two-dimensional image and converted in a plane orthogonal to the planes of the two-dimensional images only required to form the user selected three-dimensional image. Again, claims 11 and 12 cannot be rendered obvious from the teachings of these cited references.

Conclusions

In view of the foregoing it is asserted that the present claims overcome all of the Examiner's rejection and are thus patentable. An allowance of the claims is respectfully requested.